



Lucien Lagrange Architects

FS SERIES B



Vertical Hi-Rise Fan Coil Unit With Enhanced Humidity Control

Motorized Coil Bypass Damper

Temperature and
Humidity Controller

Reheat Control

Elastomeric Foam Insulation

High Efficiency, Deep Loading,
Synthetic Media Filtration

Easily Removable Coils



Johnson
Controls

The Johnson Controls hi-rise fan coil unit with enhanced humidity control changes the way the industry builds hi-rise hotels and residences in humid climates! Johnson Controls leads the fan coil industry again, with the introduction of the FS hi-rise fan coil with enhanced humidity control. The unique options of the FS with enhanced humidity control help prevent mold growth in hotel and residential spaces in humid climates when used as a part of a program to control mold.

The FS hi-rise unit mitigates conditions that contribute to mold and mildew growth when applied in a building with an adequate vapor barrier, preconditioned outside air and positive building pressurization.

Mold spores grow only in the presence of moisture and organic food materials. Mold growth is mitigated by reducing the spore count, moisture and organic dust that sustains their growth.

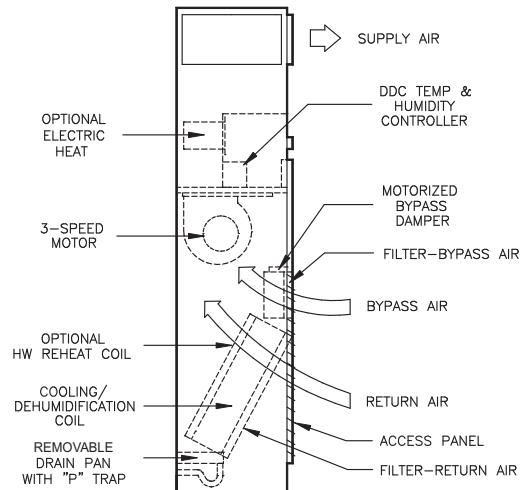
In humid climates, the greatest challenge is reducing relative humidity at part load. The major causes of mold growth in high rise hotel and residential buildings are inadequate building envelope vapor barriers, lack of pretreatment of outside air, negative building pressurization and oversizing of room air conditioning units. And traditional fan coils are oversized at part load conditions!

REDUCING SPACE RELATIVE HUMIDITY REDUCES RISK OF MOLD GROWTH WHILE ENHANCING COMFORT

The FS hi-rise unit enhances part load dehumidification by com-

The FS hi-rise unit with enhanced humidity control includes the following innovations:

- **Motorized coil bypass damper** in conjunction with fan speed control increases dehumidification at part load and more closely matches cooling capacity to the room load during off peak operation.
- **Temperature and humidity controller** improves part load relative humidity control.
- **Reheat control** for dehumidification in extreme climates.
- **Elastomeric foam insulation** inhibits moisture absorption and organic dust adhesion. The insulation itself will not sustain mold growth.
- **Deep loading, synthetic media filtration** protects both the coil and the coil bypass air from airborne contaminants. Filter media will not support mold growth.
- **Coils and piping packages are removable in minutes** for periodic cleaning outside of the unit through the standard front panel with a nut driver and a pair of wrenches.
- **Stainless steel drain pans and coil casings** are available and recommended for hotels or residences on the salty sea coast.



FS hi-rise fan coil units with enhanced humidity control are available with electric or hot water heating. Risers are not shown.

bining fan speed control and cooling coil air bypass at part load conditions as the space temperature approaches room set point. Reducing coil air flow at a constant chilled water GPM depresses the dry bulb and wet bulb temperatures and the humidity ratio of the air leaving the coil. The

result is lower room relative humidity than is achievable with standard fan coil controls and unit configurations.

COIL BYPASS AND FAN SPEED CONTROL REDUCE SPACE RELATIVE HUMIDITY

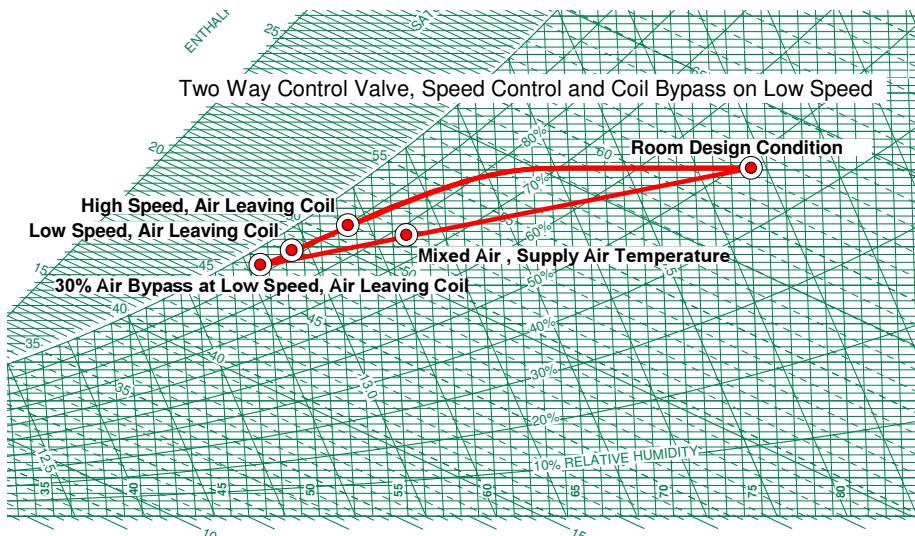
The FS hi-rise size 04 unit of

Figure 1 features a four row cooling coil, a motorized bypass damper, three-speed fan, and a

DDC temperature and humidity controller.

FIGURE 1

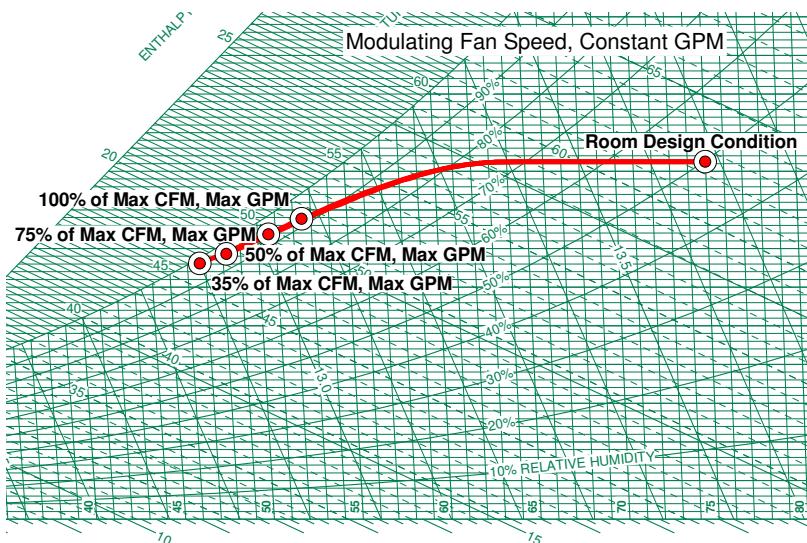
Two Way Valve Control, Speed Control and Coil Bypass on Low Speed
FSC Size 04. EWT=45°F. 4 row coil.



| | Entering Air | | Air Flow | | Water | | Leaving Air | | RH | Humidity Ratio | Dew Point | Coil | | Sensible | Coil SHR |
|---|--------------|-------------|----------|----------|-------------|-------------|--------------------------|------|------|----------------|-----------|------|------|----------|----------|
| | Dry Bulb °F | Wet Bulb °F | Coil CFM | Flow GPM | Dry Bulb °F | Wet Bulb °F | 1bs Water / 1000 lbs Air | °F | | | | SMBH | TMBH | | |
| Room Design Condition | 75 | 62.5 | -- | -- | -- | -- | 49.9 | 9.25 | 55.1 | -- | -- | -- | -- | -- | -- |
| High Speed, Bypass Closed, Coil Leaving Air | 75 | 62.5 | 440 | 2.79 | 52.5 | 51.3 | 92.4 | 7.71 | 50.4 | 10.7 | 14.0 | 100 | 0.76 | | |
| Low Speed, Bypass Closed, Coil Leaving Air | 75 | 62.5 | 270 | 2.79 | 49.3 | 48.6 | 95.3 | 7.11 | 48 | 7.5 | 10.4 | 70% | 0.72 | | |
| Low Speed, 30 % Coil Bypass, Coil Leaving Air | 75 | 62.5 | 189 | 2.79 | 47.5 | 47 | 96.5 | 6.72 | 46.6 | 5.6 | 8.0 | 52% | 0.70 | | |
| Mixed Air Temperature, Supply Air Temperature | -- | -- | -- | -- | 55.8 | 52.2 | 79.1 | 7.48 | 49.4 | -- | -- | -- | -- | -- | -- |

FIGURE 2

Modulating Fan Speed, Constant GPM. EWT=45°F. 4 row coil.



| | Entering Air | | Air Flow | | Water | | Leaving Air | | RH | Humidity Ratio | Dew Point | Coil | | Sensible | Coil SHR |
|--------------------------|--------------|-------------|----------|----------|-------------|-------------|--------------------------|------|------|----------------|-----------|------|------|----------|----------|
| | Dry Bulb °F | Wet Bulb °F | Coil CFM | Flow GPM | Dry Bulb °F | Wet Bulb °F | 1bs Water / 1000 lbs Air | °F | | | | SMBH | TMBH | | |
| Room Condition | 75 | 62.5 | -- | -- | -- | -- | 49.9 | 9.25 | 55.1 | -- | -- | -- | -- | -- | -- |
| 100% of Max CFM, Max GPM | 75 | 62.5 | 440 | 2.79 | 52.5 | 51.3 | 92.4 | 7.71 | 50.4 | 10.7 | 14.0 | 100 | 0.76 | | |
| 75% of Max CFM, Max GPM | 75 | 62.5 | 330 | 2.79 | 50.6 | 49.7 | 94.1 | 7.74 | 49 | 8.7 | 11.9 | 81% | 0.73 | | |
| 50% of Max CFM, Max GPM | 75 | 62.5 | 220 | 2.79 | 48.2 | 47.6 | 95.9 | 7.78 | 47.1 | 6.4 | 9.0 | 60% | 0.71 | | |
| 35% of Max CFM, Max GPM | 75 | 62.5 | 154 | 2.79 | 46.7 | 46.4 | 97.9 | 7.81 | 46.1 | 4.7 | 6.7 | 54% | 0.70 | | |

Compared to Figure 1, this arrangement results in less desirable humidity conditions.

The unit operates at Maximum CFM and GPM when the space temperature is well above set point. As the room temperature approaches set point, the fan speed is reduced and, just above the set point, the bypass damper is opened. The state conditions and psychrometric chart in Figure 1 show that the humidity ratio (W) of the air leaving the coil operating at low speed with 30% bypass is reduced by 13% over that of the air leaving the coil on high speed.

The mixed air temperature of 55.8°F DB is above the room dew point of 55.1°F, which will prevent sweating of the supply grille.



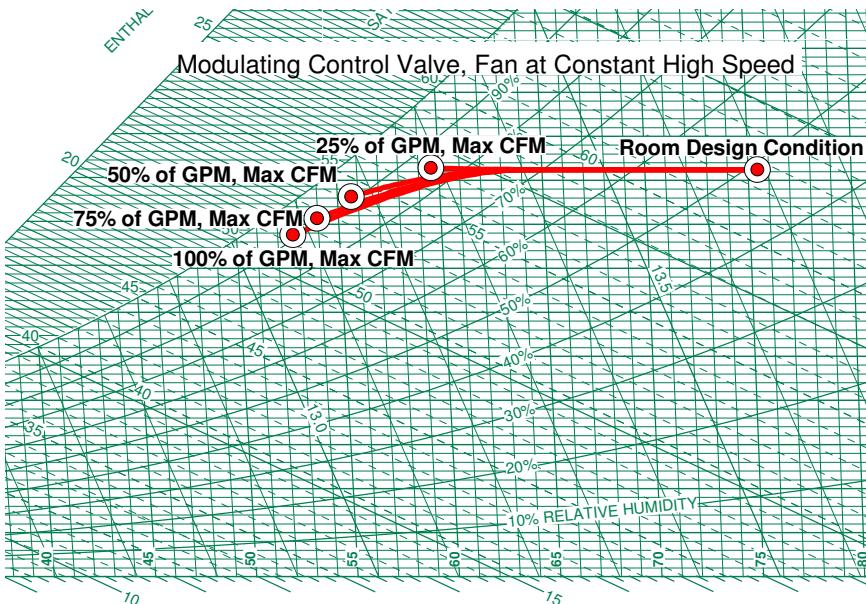
Modulating control damper opens as space humidity rises to increase latent cooling and to mix leaving and return air, raising the supply air temperature.

Air motion is very important to perceived comfort. The bypass damper provides excellent part load dehumidification and maintains a higher air flow and better air motion than can be achieved by fan modulation alone. The fan horsepower is reduced by 50% from high speed to low speed, saving power and reducing the fan and air noise from maximum cooling operation.

FAN SPEED MODULATION ALONE MAY CAUSE GRILLE SWEATING AND COLD SUPPLY AIR COMPLAINTS

Johnson Controls has applied vari-

FIGURE 3
Modulating Control Valve, Fan at Constant High Speed. EWT = 45°F. 4 row coil.



| | Entering Air | | Air Flow | | Water | | Leaving Air | | RH | Humidity Ratio | Dew Point | Coil | | Sensible | Coil SHR |
|--|--------------|-------------|----------|------|-------------|-------------|-------------|--------------------------|------|----------------|-----------|------------|------|----------|----------|
| | Dry Bulb °F | Wet Bulb °F | CFM | GPM | Dry Bulb °F | Wet Bulb °F | % | 1bs Water / 1000 lbs Air | °F | SMBH | TMBH | % Turndown | | | |
| Room Condition | 75 | 62.5 | -- | -- | -- | -- | 49.9 | 9.25 | 55.1 | -- | -- | -- | -- | -- | -- |
| 100% of GPM, Max CFM, Coil Leaving Air | 75 | 62.5 | 440 | 2.79 | 52.5 | 51.3 | 92.4 | 7.71 | 50.4 | 10.7 | 14.0 | 100 | 0.76 | | |
| 75% of GPM, Max CFM, Coil Leaving Air | 75 | 62.5 | 440 | 2.09 | 53.7 | 52.5 | 92.6 | 8.14 | 54.6 | 10.1 | 12.6 | 100 | 0.80 | | |
| 50% of GPM, Max CFM, Coil Leaving Air | 75 | 62.5 | 440 | 1.39 | 55.4 | 54.1 | 92.2 | 8.63 | 53.2 | 9.3 | 10.7 | 92% | 0.87 | | |
| 25% of GPM, Max CFM, Coil Leaving Air | 75 | 62.5 | 440 | 0.7 | 59.3 | 56.8 | 86.2 | 9.29 | 55.2 | 7.5 | 7.5 | 74% | 1.00 | | |

Compared to Figure 1, this arrangement results in less desirable humidity conditions.

able speed fan motor technologies to fan coils, air handlers and VAV terminals, but this technology alone was not selected for the FS hi-rise unit with enhanced humidity control. This is because the deterioration of room air motion and the depressed supply air temperatures caused supply grille sweating at low airflows. The psychrometric chart in Figure 2 and accompanying state points show the problems created by fan modulation alone. With a room dew point at design of 55.1°F, the supply air temperature at 50% of design air flow (48.2°F) presents supply grille condensate and cold supply air "draft" difficulties.

Others in the industry are pro-

moting modulating chilled water control valves on fan coils to reduce part load GPM and create pumping cost savings. This is a suitable strategy for dry climates where room sensible heat ratios are 0.85 or greater at all conditions. In humid climates, modulating chilled water valve control should be avoided. The Figure 3 psychrometric chart and state points demonstrate the problem that results from modulating valve control and giving the room occupant the ability to select high fan speed.

Dehumidification is always worse at part load than at full load. Once the water flow is 25% of design or lower, dehumidification is not performed at all.

REHEAT MAY BE NECESSARY IN EXTREMELY HUMID ENVIRONMENTS

The FS hi-rise unit has the capability for reheat for those situations where low room sensible heat ratios will be experienced for extended periods. If a room SHR of less than 0.75 is expected, reheat should be considered. If hot water reheat is to be used, hot water supply temperature reset from outside air temperature should be considered to avoid excessive leaving air temperatures. Electric heaters should be carefully sized to avoid excessive leaving air temperatures.

CLOSED CELL FOAM INSULATION WILL NOT HARBOR MOISTURE, DUST OR MOLD

The elastomeric closed cell foam insulation used in the FS hi-rise unit has a smooth, sealed surface. Moisture and organic material will not readily adhere to and cannot penetrate the surface of the insulation. The insulation itself will not sustain mold growth. If the insulation surface becomes dusty over time, it can be easily cleaned without damaging the insulation.

The elastomeric foam meets NFPA 90A flame, smoke spread and melting point limits. Some less expensive polyethylene foam products do not meet the melting point limit and should be avoided.

MITIGATE MOLD SPORE POPULATION AND ORGANIC DUST FOOD SOURCES

The deep loading, two stage filter media with edge sealing is

40% efficient at 1.5 microns (MERV 6), removing many mold spores that are typically 1 to 100 microns in size. The filter also removes much of the organic dust from the air stream that might serve as a food source for the growing mold.

EASY CLEANING AND MAINTENANCE

Periodic coil cleaning is necessary over the building life. The cooling coil and piping package can be removed in just a few minutes using a pair of wrenches and a nut driver. Another Johnson Controls innovation for the vertical hi-rise fan coil – stainless steel braided hoses with swivel connections on both ends – permit the isolation of the unit from the risers, removal of the hoses and draining of the connections to the coil over the unit drain pan. After removing the pop top valve actuators, the coil and piping package assembly lifts out through the return air grille and access panel. A spare coil and piping package assembly can be installed and put back in operation in 10 to 15 minutes, keeping the room in use, while the dirty coil is cleaned and inspected at a remote location before being returned to service in another unit.



Johnson Controls offers flexible, stainless steel reinforced Kevlar® hose kits as a standard feature.

STAINLESS STEEL BRAIDED HOSES AND KNOCKOUTS INCREASE UNIT FLEXIBILITY AND REDUCE COSTS OF INSTALLATION AND FIELD CHANGES

Johnson Controls has the leading technology in the fan coil industry with the application of stainless steel hose kits on stack fan coils and with riser kits that are built, pressure tested with their shut

off valves, and insulated. Riser kits are boxed by unit, tagged with floor, riser and room numbers and shipped well in advance of the fan coil units. This enables the builder to install risers quickly and early in the construction cycle as the floors are poured. Completed risers can be pressure tested and flushed before the units ever arrive on the site. This permits delaying the setting of the fan coil units until after the building is enclosed and able to **protect the fan coils from rain and construction dust keeping the units clean, dry and less likely to support biological growth**. In addition, this process can help meet LEED® credit EQ credit 3.1: Construction IAQ Management Plan – During Construction.



Riser slot knock outs on rear and sides of unit allow field reconfiguration.

Another innovation in stack fan coils from Johnson Controls are standard knock outs for supply grilles all four sides and the top of the units and in the back and both sides for riser connections. The units can be configured in the field with a pair of snips to open grille duct collars and riser access after the unit arrives on the job.



Supply air openings are lined with closed cell foam insulation

If field changes are necessary to a factory configured unit, they can easily be made. Expensive change orders and costly delays are eliminated. Not opening the supply grille until the unit is installed keeps the unit supply plenum clean and dry during shipping and staging at the jobsite, helping to prevent mold development.

FS HI-RISE FAN COIL WITH ENHANCED HUMIDITY CONTROL



Insulated drain pan with factory installed pre-formed p-trap.

REMOVABLE DRAIN PAN, A JOHNSON CONTROLS INNOVATION

The optional removable drain pan is an exclusive Johnson Controls innovation. The drain pan can be removed, cleaned, and quickly replaced.

Contact your Johnson Controls representative for assistance with our browser based selection program, Web-Select®. The program corrects for elevation and prints fan curves, coil selections, and electrical data.

SUGGESTED GUIDE SPECIFICATION

MOTORIZED COIL BYPASS DAMPER

Provide a motorized two-position coil bypass damper. Damper shall be sized such that when it is opened, 30% of the fan airflow capacity will be drawn through the damper opening, bypassing the cooling coil.

INSULATION

Provide elastomeric foam insulation. Insulation density shall be a minimum of 3 pounds per cubic foot. Insulation shall meet all requirements of NFPA 90-A flame and smoke spread, and melting point. Polyethylene insulation is not acceptable.

FILTERS

Provide 1 inch self-gasketing filter consisting entirely of synthetic media and frames. Filter shall be tight fitting to prevent air bypass. Filter shall be easily removable from the return air opening with the front panel removed. Filter efficiency shall be 40% at 1.5 microns (MERV 6).

UNIT HANDLING AT JOB SITE

Provide factory fabricated risers with isolation valves, factory pressure tested under water, shipped separate from the fan coil unit. Risers shall be installed, pressure tested, filled and flushed, and floor slab shall be fire safed prior to the fan coil units being delivered to the job site. Fan coil units should be installed as late as possible in the construction phase to help protect the units from construction dust.

NON-MODULATING CONTROL VALVES

Provide a standard factory assembled valve piping package to consist of a 2 or 3 way, on/off, motorized electric control valve and two ball isolation valves.

DRAIN PAN

Provide an insulated drain pan with factory installed pre-formed p-trap. Option: Provide a removable drain pain to allow for proper cleaning. Option: Drain pan should be constructed of stainless steel or a non-ferrous material.

STAINLESS STEEL COIL CASING

Option: Provide stainless steel coil tube sheets.

UNIT KNOCK OUTS

Provide fan coil units with standard knock outs for supply grills on all four sides and the top of the units, along with knock outs for riser connections in the back and both sides of the unit to allow for field configuration and to help in keeping the units clean.

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